

# Index

- Acoustic emission, 64–68
  - characteristics, 65–66
  - equipment, 66–68
  - monitoring, 173–174
- Aggregates, 101–103
  - artificial, 102–103
  - compaction, 116
  - laboratory tests, 81–82
  - natural, 101–102
  - nominal size, 12, 34, 45
  - open-graded, 12–14, 34, 102
  - recommended maximum size, 116
  - sieve sizes, 101–102
  - well-graded, 12–13, 102
- Agricultural drainage, 123–124
- Algae, 75, 174
- Apparent opening size, 34, 82
- Aquifers, 21–25, 44
  - assessment of, 57–60
  - characteristics of, 23–25
  - confined, 21–24, 58–59, 74–75, 86–87, 147, 160–161
  - definition of, 21
  - detection and classification of, 57
  - impermeability of, 21
  - leaky, 22, 24–25
  - perched, 22–23
- Aquifers—*Continued*
  - permeability of, 21
  - unconfined, 22, 25, 58–59, 74–75, 86–87, 161–162
- Artesian condition, 22, 147
- Augering, 51
- Blanket drains, 130–133, 143–144
  - excavation for, 113–114
- Blinding, *see also* Clogging, 175
- Bridging layer, 36–38
- Calcium, 82
- California stabilization trench drain, 144–145
- Carbon dioxide, 16
- Clogging, 34, 44, 175–181
  - calcium carbonate, 102–103, 179–180, 182–183, 186
  - chemical treatment for, 187
  - granular, 175–177
  - ochre, 82, 177–179, 182–183, 186
  - tree roots and, 186–187
- Closed circuit television, 187
- Coefficient of permeability, 10
  - geological structures, 15–16
  - geotextiles, 15

- Coefficient of permeability—*Continued*  
 granular materials, 13–14  
 open-graded aggregates, 14  
 packer test, 60, 87–88  
 pumped well tests, 58–60, 85–87  
 standpipe piezometer test, 58, 84–85
- Coefficient of uniformity, 12–13, 38–39
- Core drilling, 51
- Creep, 8–9, 45, 100
- Cribwalls, gabions, 140–142
- Darcy's law, 10–11
- Development, filter, 36–39, 183
- Dynamic effects, *see also* Seismic effects, 7, 116
- Dynamic sounding, 53
- Earth pressure, 133–138  
 due to compaction, 134–138
- Electrical resistivity, 54–55
- Equipotential lines, 18–19
- Excavation, 112–115  
 close sequence procedure, 113, 142, 192
- Factor of safety, 2–3  
 flow in granular materials, 17–18, 131, 133  
 flow in geocomposites, 30, 128, 132–133  
 flow in geotextiles, 18  
 flow in pipes, 30  
 slope stability, 92
- Ferric/bacterial clogging, *see* Clogging, ochre
- Filter design  
 geotextile, 33–36  
 granular, 32–33
- Filter, development of, 36–39, 183
- Filtration, filtration function, 31  
 industrial filtration, 176
- Finite elements, 92, 124
- Flow capacity, 44–46
- Flow lines, 18, 90
- Flow net, 18–19, 89–90, 122  
 construction methods, 19–21  
 flow in geological structures, 20
- Flow rate, flux, in geotextiles, 15
- Flowing artesian condition, 22, 77, 197
- Geocomposites, 15, 106–108, 115, 128–129, 131
- Geotextiles, 103–106  
 damage, 114–115  
 filters, 33–36  
 hydraulic properties of, 15, 18, 82  
 lapping and sewing, 114  
 placement in clay mud, 115–116  
 polymers, 104  
 storage, 114  
 survivability, 34–36, 82  
 thread, 104–105  
 types, 105–106
- Groundwater  
 “memory” of, 42–43  
 sampling, 54  
 testing, 55, 82–83
- Head, Piezometric, *see* Piezometric pressure
- Horizontal drains, 146–158, 194–196  
 design, 147–151  
 drilling equipment, 151–153  
 geotextile sleeve, 155  
 outlets, 158  
 permanent casing, 153–155  
 placement, 155–158
- Impermeable, 21
- Inclinometer  
 borehole in, 70–72  
 installation of, 72  
 poor man's, 69–70
- Instrumentation, 62–79  
 combined, 78–79  
 indication, 117–118  
 placement, 60  
 security capping, 77–78
- Interceptor drain, 41–42, 45, 120–123, 130
- Laboratory tests, 80–83  
 aggregate, artificial, 81–82  
 aggregate, natural, 81

- Laboratory tests—*Continued*  
 geotextiles, 82  
 groundwater, 82–83  
 pipe, 82  
 rock, 81  
 soil, 80–81  
 Laminar flow, 16, 26  
 Landslide features, terminology, 49–50  
 Limit equilibrium, 91–92  
 Liquefaction, *see* Dynamic effects  
 Low permeability, 21, 44, 47, 192
- Maintenance, 182–187  
 jet cleaning, 183–187  
 routine, 183  
 schedule, 118, 182–183  
 Map of site, 49–50  
 Model, geotechnical, 60–61  
 Monitoring, 169–174  
 frequency, 169–170  
 sequence, 170–171  
 Movement measurement, *see also*  
 Acoustic emission  
 crack measurements, 64, 174  
 surveying methods, 63–64, 174
- Natural fabrics, 108
- Observation well, 73  
 Ochre, 47, 82, 177–179, 188–189
- Panel drain, 108, 128–129  
 Passive drain, 41–42, 45, 123–126  
 Permeability, granular materials, factors  
 affecting, 11–13  
 Permeable, 21, 44  
 Permittivity, 15, 34, 82  
 Piezometers, standpipe, 72–77  
 basic time lag of, 84–85, 172  
 installation of, 74–75  
 maintenance of, 172  
 reading devices for, 75–77  
 response time, 72–73  
 rising/falling head test, 58, 84–85,  
 172  
 shape factor, 84–85  
 Piezometric gradient, 10  
 Piezometric level, maximum, 88–89  
 Piezometric pressure, 1–2, 44  
 effect on stability, 3–6  
 Pipe flow, resistance to, 27–28  
 Pipes, 108–111  
 corrugated perforated plastic, 29–30,  
 110–111  
 open jointed, 109–110  
 outlets, 117–118, 127, 158  
 placement of, 117  
 PVC, 29, 111, 153–154  
 Piping of fine particles, 31  
 Plasticity index, 52  
 Pore pressure, 2  
 Porosity, 11  
 Prestressed ground anchors, 145  
 Protected material (base), 31, 36–39  
 Pump operation, 165–166  
 Pumped wells, 159–166, 196–197  
 Pumping systems, 162–166
- Rain gauge, 79  
 Reinforced soil, 143–144, 193–194  
 Relief wells, 166–167, 197–198  
 Residual shear strength, 81  
 Retaining structures, 130–145  
 Retaining walls, 138–140  
 Reynolds number, 26–27  
 Rising/falling head test, 58, 84–85  
 Rock joints, 50, 81  
 Rock quality designation, 52  
 Rockfill buttresses, 141–143, 192–193
- Sampling  
 groundwater, 54  
 rock, 54  
 soil, 54  
 Seismic effects, 99, 116  
 Separation function, 31  
 Siphons, 167–168  
 Site log, 118, 169, 182  
 Site visit, 49  
 Slices, 2–3  
 Stab trenches, *see* Trench drains, Cali-  
 fornia Stabilization  
 Stability analysis, 91–100  
 back analysis, 99

Stability analysis—*Continued*

- choosing a method, 96–98
- mode of failure, 98
- probabilistic methods, 99–100
- rock, 95–96
- sensitivity assessment, 100
- soil, 92–95

Stability analysis parameters

- rock, 95
- soil, 92–93

Standard penetration test, 53–54

Static cone penetrometer, 53

Storativity, 23–25, 86

Subsurface drainage, principles of, 7–8

Sump, 138

Surface of rupture, 50

- location, 55–57, 69–72, 171

Synthetic fabrics, *see* Geocomposites,  
Geotextiles

Système International, xiii

Terrain evaluation, 50

Test pits, 51

Time domain reflectometry, 70–71

- installation of, 72

Transmissivity, 15, 23–25, 86, 131, 133

Tree roots, 180–181, 186

Trench drains, 119–129

- California stabilization, 144–145
- development of, 119–121

Trench drains—*Continued*

- excavation of, 112–113
- parallel to slope, 123–126, 191–192
- square to slope, 120–123, 190–191
- water movement in, 126–128

Triaxial shear strength, 52, 81

Turbulence, turbulent flow, 16, 26

- in granular materials, 16–17

- in geotextiles, 17

- in pipes, 26–28

Vane shear apparatus, 52

Velocity, discharge, 11

- seepage, 11

Volume flow rate

- in aggregates, 46
- in cylindrical pipes, 28–29
- in corrugated pipes, 29–30
- in dry weather, 45–47
- maximum from a slope, 89–90
- monitoring from a drain, 173, 186
- reduced in geotextiles, 18
- reduced in granular materials, 17–18

Water table, 20

- aquifer, 22

Wells, 159–168

- drawdown, 160–161

- radius of influence, 160–161

Work-as-executed drawings, 118